DOCUMENT NUMBER 175

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

MODEL 101 AC/DC CONVERTER

PROT. of 814 METER ROOM

NON-LINEAR SYSTEMS, INC.
DEL MAR AIRPORT,
DEL MAR, CALIFORNIA

MP MASTER
MA33788

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MODEL 101 AC/DC CONVERTER

INTRODUCTION

This handbook contains the instructions relative to the operation and maintenance of the Model 101 AC/DC Converter, manufactured by Non-Linear Systems, Inc., Del Mar, California. It is presumed that the personnel responsible for this equipment are skilled technicians, and as such, the information presented herewith is for operation and maintenance by personnel who need only familiarizations.

The handbook is composed of five chapters. One, Description; two, Operation; three, Adjustment; four, Theory of Operation; and five, Trouble Shooting. Each chapter title is self-explanatory of the chapter contents.

This handbook makes no attempt to provide any repair information or define spare parts. If such information is required, please communicate with the factory representative or the main plant.

DESCRIPTION

The Model 101 AC/DC Converter consists of appropriate electronic components, arranged on a printed circuit board to convert unknown AC voltage. The converted AC(DC) voltage may then be measured by the DC Digital Voltmeter. The unit is mounted beneath the digital voltmeter. A Jones strip on the back of the converter interconnects the converter output to the digital voltmeter input, and provides input terminals for the unknown voltages to be measured. (Terminals 1 and 2.)

Voltages ranging from 0 to 10V AC, 100V AC and 1,000V AC may be measured in conjunction with the use of the manual range selector.

OPERATION

Having observed the instructions for putting the digital voltmeter into operation proceed as noted in the following steps to measure AC voltage. Set the selector switch on 10V. The unknown input up to 9.999 volts will be displayed with the letters AC in the left window of the digital voltmeter readout. If the unknown input is greater than 10 volts while the selector is in the 10 volt position, the readout will continue to display 9.999 volts AC. This is the only indication that the voltage is higher than 10 volts and that the selector must be reset to the 100 volt or the 1,000 volt position.

Set the selector switch on 100 volts or 1,000 volts to measure voltage in these ranges. The readout display will be up to the value indicated by the selector setting. The resolution of the converter is 0.1% and the readout display will continually follow an input source which has this variation or greater.

The instrument has a response proportional to the average of the absolute magnitude of the voltage. The calibration is, however, made to display the corresponding value of RMS voltage.

The readings will agree with an instrument whose readings are proportional to the RMS value of the voltage, provided that the input voltage is a pure sinusoid.

An example of the differences between RMS values and the displayed value of the Model 101 is given by the following table.

SECOND HARMONIC

% Harmonic	Possible Error
10%	±.25%
20%	-2%
50%	-12%

THIRD HARMONIC

10%	±4%
20%	±6%
50%	+4 to -22%

ADJUSTMENT

All the adjustment controls to recalibrate the converters are located beneath the front plate on which the selector markings are located. See Figure 1 for the controls and their location.

To make adjustments proceed as follows:

1. Standardize the instrument on DC in accordance with the instructions given in 4-1 of Operation and Service Instructions of Model 451. If the digital voltmeter incorporates Model 201 Automatic Calibrator, this step will be completed automatically.
2. Set the range selector switch on 10V. Feed a sinusoidal voltage into the calibrator of 8 to 10 volts RMS value at a frequency between 60 and 500 cps.

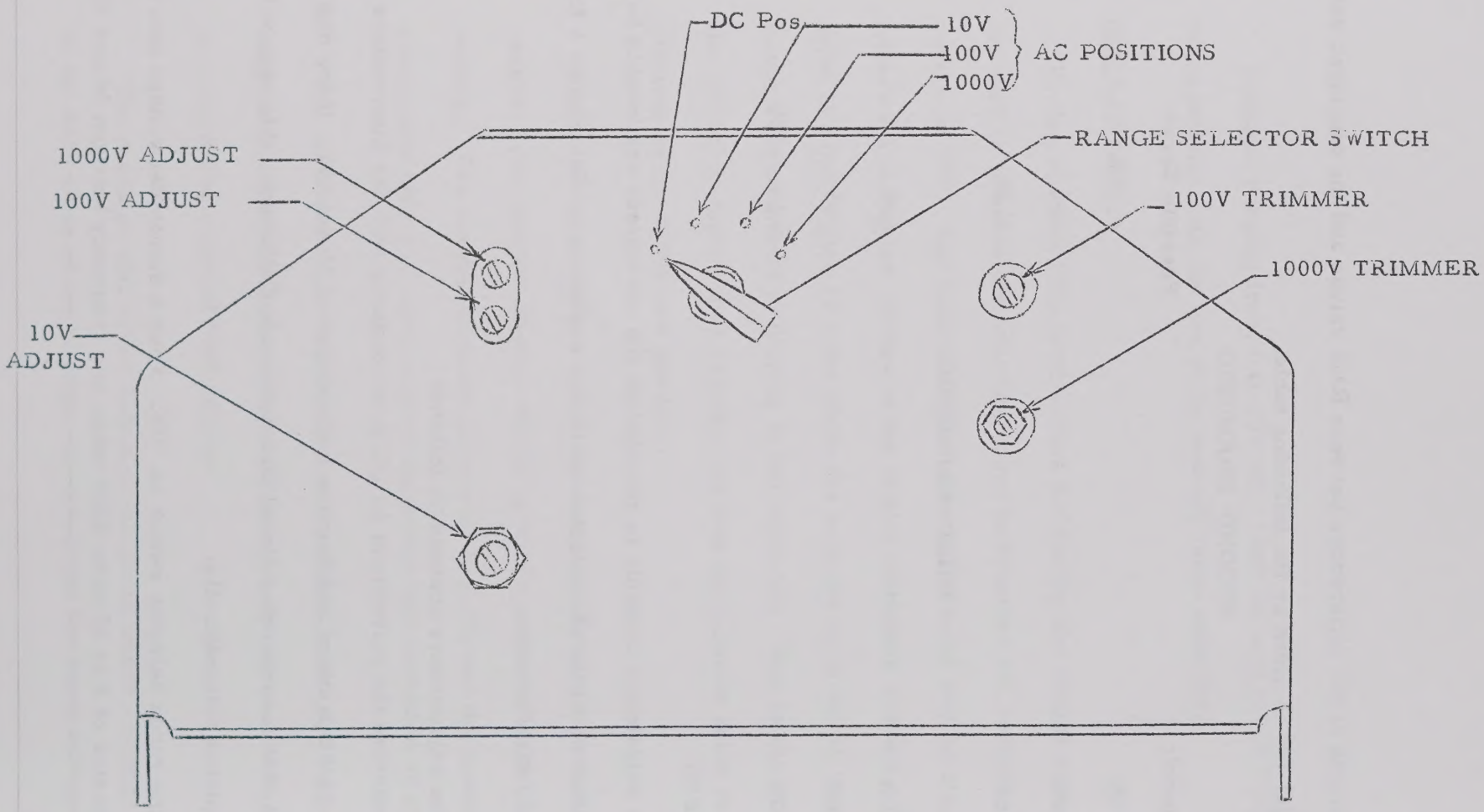


FIG. 1

REF: 18014-001

PORTION OF MODEL 101 AC-DC CONVERTER

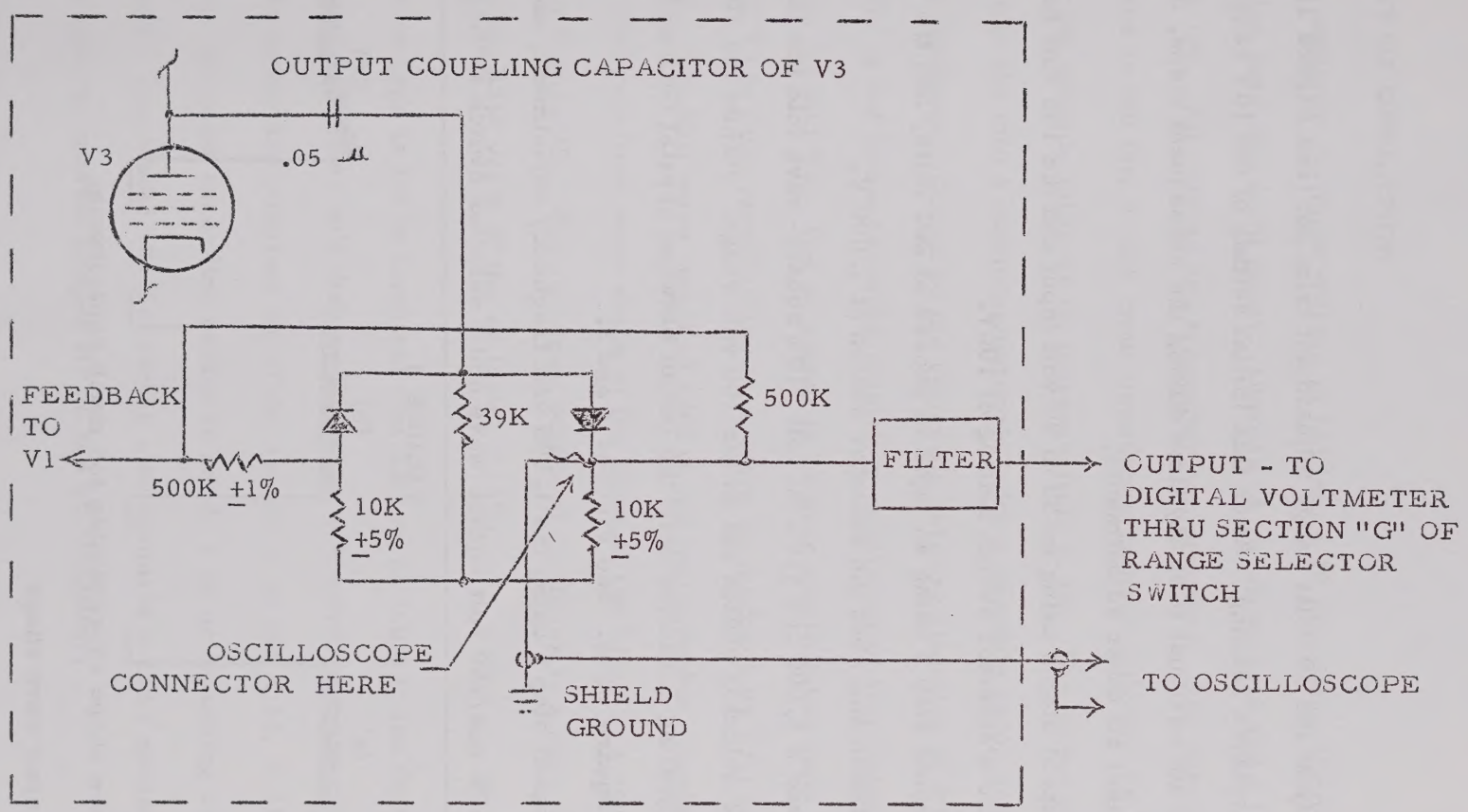


FIG. 2

REFER TO DWG #18014 SHT 2
FOR COMPLETE SCHEMATIC

Adjust the 10 volts range adjustment trim pot (see Figure 1) to the correct displayed reading. After this initial setting of the 10V range adjustment, do not readjust it at any time during the subsequent steps, or it will affect all other adjustments.

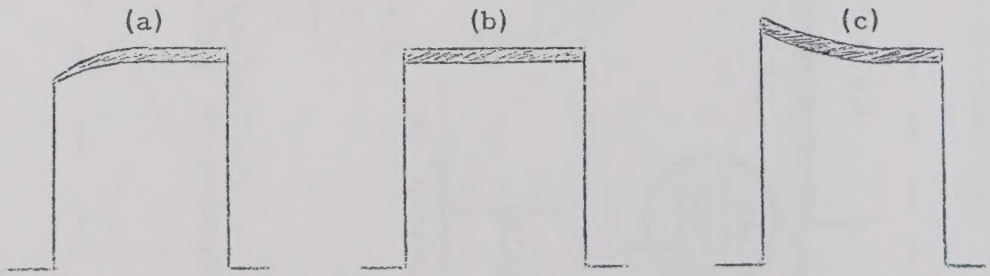
3. Repeat step 2 using an 80 to 90 volt input and the 100 volt range adjustment with a selector switch setting of 100V.

4. Repeat step 3 using an input in excess of 200 volts, and the 1,000 volt range adjustment. Set the selector switch at 1,000 V.

5. Feed a 1,000 cps ±10% 50 volt ±10% square-wave into the instrument with the selector switch set on the 100 volt range. Adjust the 100 volt frequency adjusting capacitor until the output between crystal CR2 and resistor R36 is a square wave. See Figures 2 and 3.

6. Repeat step 5 using the 1,000 volt frequency adjustment, an input of 1,000 ±10% cps/200 volt square wave and a selector switch setting of 1,000V.

FIGURE 3



3(a) Wave shape representing too much capacitance.

3(b) Proper wave shape.

3(c) Wave shape representing too little capacitance.

THEORY OF OPERATION

The unknown AC input voltage is fed into a 10 meg input attenuator manually controlled from the front panel. Outputs of the attenuator are 1 to 1; 1 to 10; and 1 to 100. All outputs are frequency compensated. The output of the attenuator is fed into a high input impedance cathode follower V4 and V5. Gain of the cathode follower is approximately 0.98. The output of the cathode follower is fed into a summing network, with a variable gain, and is summed with the feedback. Output of the summing network (junction of R15, R19, R33, and R37), is fed into a two-tube amplifier consisting of two matched 5879 pentodes, V1 and V2. The ac signal is further amplified by tube V3. The output of V3 is fully rectified for a negative dc feedback by CR1 and CR2 crystals. The half wave output of CR2 is fed into a double-parallel "twin T" filter. The resultant wave shape at the input of the filter is a square wave as shown in Figure 3B. The resultant output of the filter is a pure dc voltage equal to the RMS value of the ac input, $\pm$.1%.

This voltage is fed to terminal 3 of TB1 as dc input to the digital voltmeter. The digital voltmeter will display DC in the left window, if the range selector switch is on the DC position; AC if the switch is on the X 10, X 100, or X 1000 position. If a print recording device is used, a dc or ac coding symbol will also be printed. The Model 101 Converter also contains a 280 V series regulated power supply to provide proper B+ to the ac amplifier.

Drawing No. 18014, sheet 2 is self explanatory as to operation and shows dc voltages (encircled), ac voltages (in boxes) and wave shapes at all critical test points for trouble shooting purposes.

TABLE I - TROUBLE SHOOTING

When attempting to trouble-shoot the instrument, it is recommended that drawing 18014, sheet 2 be used for voltage and wave shapes at the test points. Voltages are subject to a 10% tolerance except for the input and output. Also, the wrong readings at various test points may be the result of poor solder connections, broken resistors, leaky capacitors or faulty tubes.

Trouble	Probable Cause	Remedy
Non-linearity in converter	Non-linearity in input attenuator.	Recalibrate in accordance with procedure given under "Adjustment".
	Noisy resistor in input attenuator.	Replace resistor
	Leaky capacitor in input attenuator.	Replace capacitor.
	Insufficient gain out of tubes V1 and V2.	Balance the replacement 5879 tubes to give a plate voltage of 90-122 volts DC at pin 8 of tube V2.
	Faulty tubes. WARNING: Do not remove V9 5651 with the instrument ON; damage to V3 will result.	Replace tubes and match 5879 as noted above.
Not able to calibrate the output 0-10V position.	Insufficient gain in V1 and V2	Balance the replacement 5879 tubes to give a plate voltage of 90-122 volts DC at pin 8 of tube V2.

Trouble	Probable Cause	Remedy
	Insufficient feedback voltage and/or too much resistance in R15	Lower the resistance in R15. a. Shunt R15 with a 2.7 meg or higher resistor. b. If more shunting is required, check the break voltage of CR1 and CR2. The time period between "conduction" and "no conduction" should be symmetrical between the two. Replace CR1 and CR2 if this symmetry can not be established.

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